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ABSTRACT

This is a comparative study of a school utilizing a mini-course science elective curriculum and one using a conventional textbook program in order to investigate the effectiveness of mini-course programs with respect to students' achievement and attitudes toward science. Two suburban junior high schools were selected, and different instructional approaches were utilized in the two schools to teach similar course content, over a period of the whole school year. A nonrandomized Control-Group Pretest-Posttest Design was employed, and two instruments, the Test of Science Knowledge (TOSK) Part II, and a Scientific Attitude Inventory were administered. There was no significant difference in mean achievement or attitude gain scores between the schools, and there was no significant relationship between achievement or attitude scores and general ability across the experimental and control groups for students of different sex or grade level. (Author/GA)

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An Achievement and Attitudinal Comparison of an Elective Mini-Course Science Curriculum and a Conventional Non-Elective Science Curriculum at the Junior High School Level

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An Achievement and Attitudinal Comparison of an Elective Mini-Course Science Curriculum and a Conventional Non-Elective Science Curriculum at the Junior High School Level 1

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RATIONALE AND OBJECTIVES

During the last decade curricular revitalization to achieve individualization and relevance has included science programs that offer student electives in the form of "mini-courses."

It appears that the idea of the elective mini-course curricula will continue to expand in the years ahead as an alternative instructional approach. In view of the apparent lack of published and scientifically oriented studies denoting the effectiveness of mini-courses, several questions are pertinent at this time. Are the elective mini-course programs better than what had been taught previously? Does the new approach make a difference in student achievement? Are there students for which an elective program results in greater achievement or a better attitude toward science? What effect does a random ordering of courses have upon student learning? Are the attitudes of students toward science affected as a result of the elective programs?

Obviously, the recent rapid growth of elective programs must be recognized. The answers to these questions would be most helpful in justifying their continued growth and to assist in building better curricula and improving instruction. A comparative study, between a school utilizing a science elective curriculum and one using a conventional textbook program was completed to hopefully provide answers to such questions by measuring gains in student achievement and attitude. In retrospect, different instructional approaches were utilized in the two schools to teach similar course content. The elective program featured a series of non-sequential and non-graded mini-courses. Students elected eight different mini-courses each year; each course having a 4½ week duration.

METHODOLOGY AND DESIGN

A longitudinal study utilizing a "Nonrandomized Control-Group Pretest-Posttest Design" was employed. The experimental and control groups consisted of grade 7 and 8 science students at two junior high schools in a suburban Pittsburgh, Pennsylvania school district. The independent variables were the respective mini-course elective and conventional non-elective science programs of instruction. The dependent variables were scores from the achievement tests and attitude inventory utilized in the study. The statistical similarity of the two student populations was confirmed by data from a socio-economic survey and by comparing the group intelligence scores.

The investigation was conducted during the course of the complete 1975-1976 school year.

INSTRUMENTS, DATA, AND RESULTS

The Test of Science Knowledge (TOSK), Part II, was administered at the beginning of the school year in September, 1975, and repeated at the termination of the course in June, 1976, as a criterion measure to determine the amount of mean achievement gains. A Scientific Attitude Inventory was also administered as a pretest and posttest measure to assess gains in scientific attitudes of the students in each treatment. The effects of non-sequential and sequential presentation of subject matter upon cumulative mean achievement gains was monitored also by administration of the Cooperative Science Tests, General Science, forms A and B, to each grade at 9 week intervals. A "Three-Factor Mixed Design: Repeated Measures on One Factor" was utilized to obtain the gain scores analyses.

Aptitude-Treatment Interactions (ATI) were studied also as the basis for determining what effect various personological variables have upon student achievement and attitude in both of the programs. In this study, the personological variables were grade level and sex as a function of mental ability upon the

achievement and attitude criterion measures. All possible combinations of grade level and sex were studied to compare the experimental and control groups. Simple regression equations were utilized to test the slope of the pairs of regression lines for the existence of aptitude treatment interactions at each level specified below:

1. males, grade 7
2. females, grade 7
3. males, grade 8
4. females, grade 8
5. males and females, grade 7
6. males and females, grade 8
7. males, grade 7 and 8
8. females, grade 7 and 8

The .05 level of significance for rejecting or not rejecting the null hypotheses for equality of population means and homogeneity of regression equations was utilized in the data analysis.

Test results are found in tables 1-6. Figures 1-4 present the scientific attitude profiles.

TABLE 1

RESPECTIVE ACHIEVEMENT AND ATTITUDE PRE AND POSTTEST MEANS, VARIANCES, AND GAIN SCORES FOR TOTAL GROUPS

Group	N	Pretest Mean	Posttest Mean	Variance	Gains
		Test of Science Knowledge-II			
Exp. 7	97	18.67	18.91	40.87	+0.24
Exp. 8	126	19.77	19.99	47.20	+0.22
Control 7	140	18.83	19.50	40.95	+0.67
Control 8	166	19.86	21.24	64.10	+1.38
		Cooperative Science Test-A			
Exp. 7	97	26.42	26.81	123.15	+0.39
Exp. 8	126	26.38	27.60	113.94	+1.22
Control 7	140	25.80	29.44	101.95	+3.64
Control 8	166	25.98	28.58	121.57	+2.60
		Cooperative Science Test-B			
Exp. 7	97	27.49	28.68	118.34	+1.19
Exp. 8	126	28.68	28.85	134.51	+0.17
Control 7	140	30.83	31.24	137.91	+0.41
Control 8	166	32.78	31.11	122.88	-1.67
		Scientific Attitude Inventory			
Exp. 7	97	107.98	105.85	262.93	-2.13
Exp. 8	126	105.33	103.06	2909.74	-2.27
Control 7	140	110.22	112.55	119.85	+2.33
Control 8	166	106.34	103.89	304.95	-2.45

TABLE 2

ANALYSIS OF VARIANCE WITH REPEATED MEASURES ON SCORES ON THE TEST OF SCIENCE KNOWLEDGE, PART II, AND SCHOOLS

Source	Sum of Squares	Mean Squares	DF	F Ratio
Between Subjects				
Grade 7/8	409.7548	409.7548	1	4.93 *
Exp/Control Treatment	67.32330	67.32330	1	0.81
Grade X Treatment	13.20405	13.20405	1	0.16
Error	43660.34	83.16254	525	
Within Subjects				
Tests	132.2079	132.2079	1	8.15 *
Tests X Grade	9.769410	9.769410	1	0.60
Tests X Treatment	44.09612	44.09612	1	2.72
Tests X Grade X Treatment	9.276407	9.276407	1	0.57
Error	8521.650	16.23171	525	

[F (1,525), $p < .05 = 3.86$]

Decision: Do not reject the null hypothesis.

(*$p < .05$)

Conclusions:

1. The grade level of the subjects affected the respective performances on this test.

2. All subjects did learn as reflected in the positive gain scores for this test.

However, there is no significant difference in mean achievement gain scores between schools.

TABLE 3

ANALYSIS OF VARIANCE WITH REPEATED MEASURES ON SCORES ON THE COOPERATIVE SCIENCE TEST, FORM A, AND SCHOOLS

Source	Sum of Squares	Mean Squares	DF	F Ratio
Between Subjects				
Grade 7/8	0.7360267	0.7360267	1	0.01
Exp/Control Treatment	95.65803	95.65803	1	0.81
Grade X Treatment	31.25122	31.25122	1	0.26
Error	62123.23	118.3300	525	
Within Subjects				
Tests	1211.176	1211.176	1	10.88 *
Tests X Grade	6.068525	6.068525	1	0.05
Tests X Treatment	317.4845	317.4845	1	2.85
Tests X Grade X Treatment	53.01706	53.01706	1	0.48
Error	58465.25	111.3624	525	

[F (1,525), $p < .05 = 3.86$]

Decision: Do not reject the null hypothesis.

(*$p < .05$)

Conclusion:

All subjects did learn as reflected in the positive gain scores for this test.

However, there is no significant difference in mean achievement gain scores between schools.

TABLE 4

ANALYSIS OF VARIANCE WITH REPEATED MEASURES ON SCORES ON THE COOPERATIVE SCIENCE TEST, FORM B, AND SCHOOLS

Source	Sum of Squares	Mean Squares	DF	F Ratio
Between Subjects				
Grade 7/8	144.3623	144.3623	1	1.10
Exp/Control Treatment	2416.969	2416.969	1	18.40 *
Grade X Treatment	31.27726	31.27726	1	0.24
Error	68959.39	121.3512	525	
Within Subjects				
Tests	6.511342	6.511342	1	0.05
Tests X Grade	168.8492	168.8492	1	1.34
Tests X Treatment	114.6566	114.6566	1	0.91
Tests X Grade X Treatment	24.87104	24.87104	1	0.20
Error	66279.61	126.2469	525	

[F (1,525), $p < .05 = 3.86$]

Decision: Do not reject the null hypothesis.

(*$p < .05$)

Conclusion: The type of instructional program (experimental versus control) affected the respective performances on this test.

However, there is no significant difference in mean achievement gain scores between schools.

TABLE 5

ANALYSIS OF VARIANCE WITH REPEATED MEASURES ON SCORES ON THE SCIENTIFIC ATTITUDE INVENTORY, AND SCHOOLS

Source	Sum of Squares	Mean Squares	DF	F Ratio
Between Subjects				
Grade 7/8	6087.157	6087.157	1	6.35 *
Exp/Control Treatment	1767.669	1767.669	1	1.85
Grade X Treatment	673.0599	673.0599	1	0.70
Error	503046.8	958.1845	525	
Within Subjects				
Tests	306.0123	306.0123	1	0.33
Tests X Grade	548.7707	548.7707	1	0.59
Tests X Treatment	238.6635	238.6635	1	0.26
Tests X Grade X Treatment	319.9707	319.9707	1	0.35
Error	486942.1	927.5087	525	

[F (1,525), $p < .05 = 3.86$]

Decision: Do not reject the null hypothesis

(*$p < .05$)

Conclusion:

The grade level of the subjects affected the respective performances on this test.

However, there is no significant difference in mean attitude gain scores between schools.

TABLE 6

MEAN SCORES OF GRADE 7 AND 8 STUDENTS ON THE POST SCIENTIFIC ATTITUDE INVENTORY

Experimental - Grade 7												
Scale	1-A	1-B	2-A	2-B	3-A	3-B	4-A	4-B	5-A	5-B	6-A	6-B
Mean	9.4	7.9	9.6	10.5	8.1	10.4	8.7	5.9	9.1	9.4	7.8	8.7

Experimental - Grade 8												
Scale	1-A	1-B	2-A	2-B	3-A	3-B	4-A	4-B	5-A	5-B	6-A	6-B
Mean	9.0	7.5	9.8	10.3	7.9	10.1	8.4	5.9	9.1	9.4	6.7	8.2

Control - Grade 7												
Scale	1-A	1-B	2-A	2-B	3-A	3-B	4-A	4-B	5-A	5-B	6-A	6-B
Mean	9.1	7.6	9.7	10.5	7.7	10.3	8.8	6.0	9.4	9.9	8.4	9.2

Control - Grade 8												
Scale	1-A	1-B	2-A	2-B	3-A	3-B	4-A	4-B	5-A	5-B	6-A	6-B
Mean	8.9	7.9	9.5	10.7	7.9	10.7	8.4	5.8	9.0	9.9	8.3	9.1

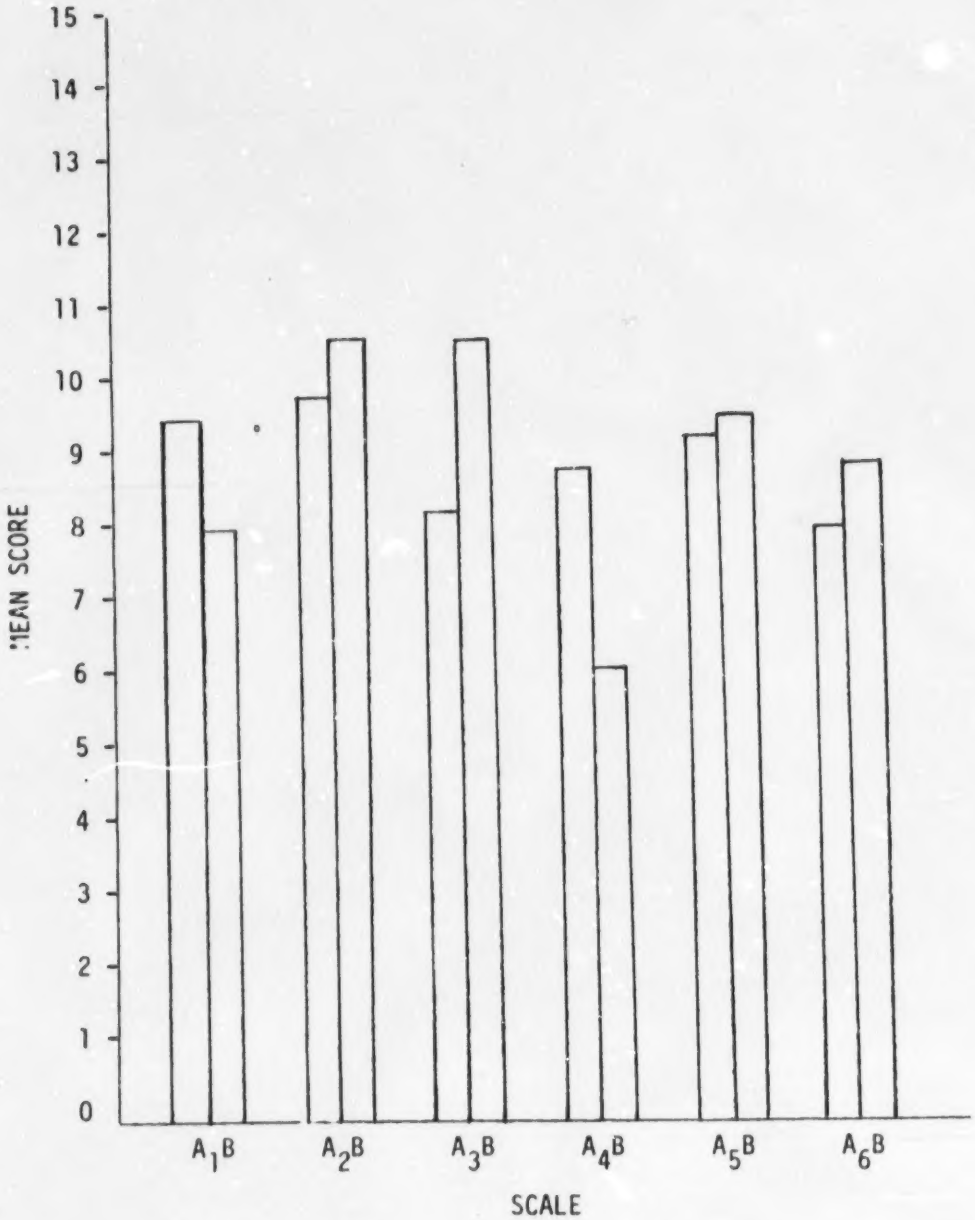

Figure 1. Profile of Mean Scores of Experimental Grade 7 Students on the Scientific Attitude Inventory.

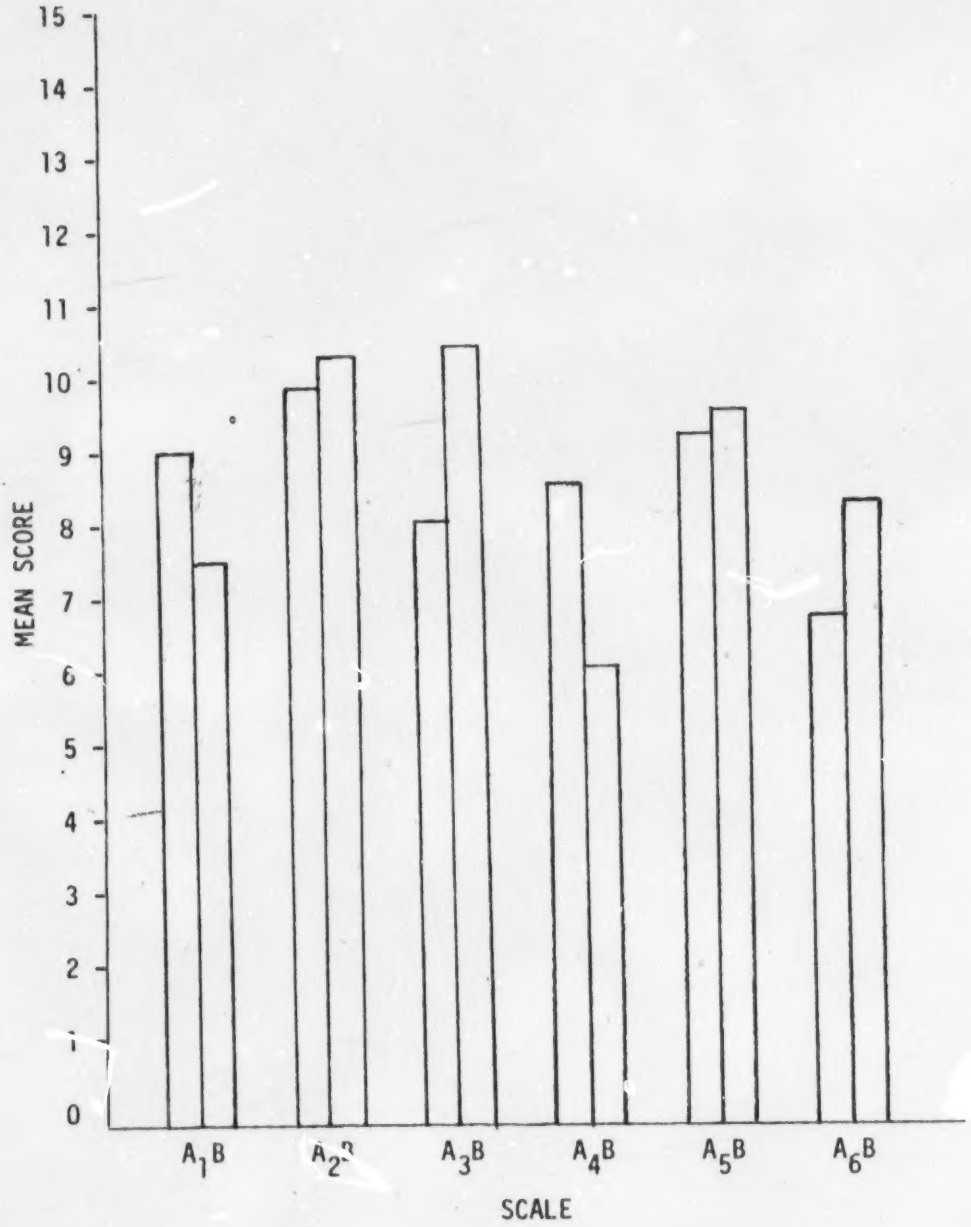

Figure 2. Profile of Mean Scores of Experimental Grade 8 Students on the Scientific Attitude Inventory.

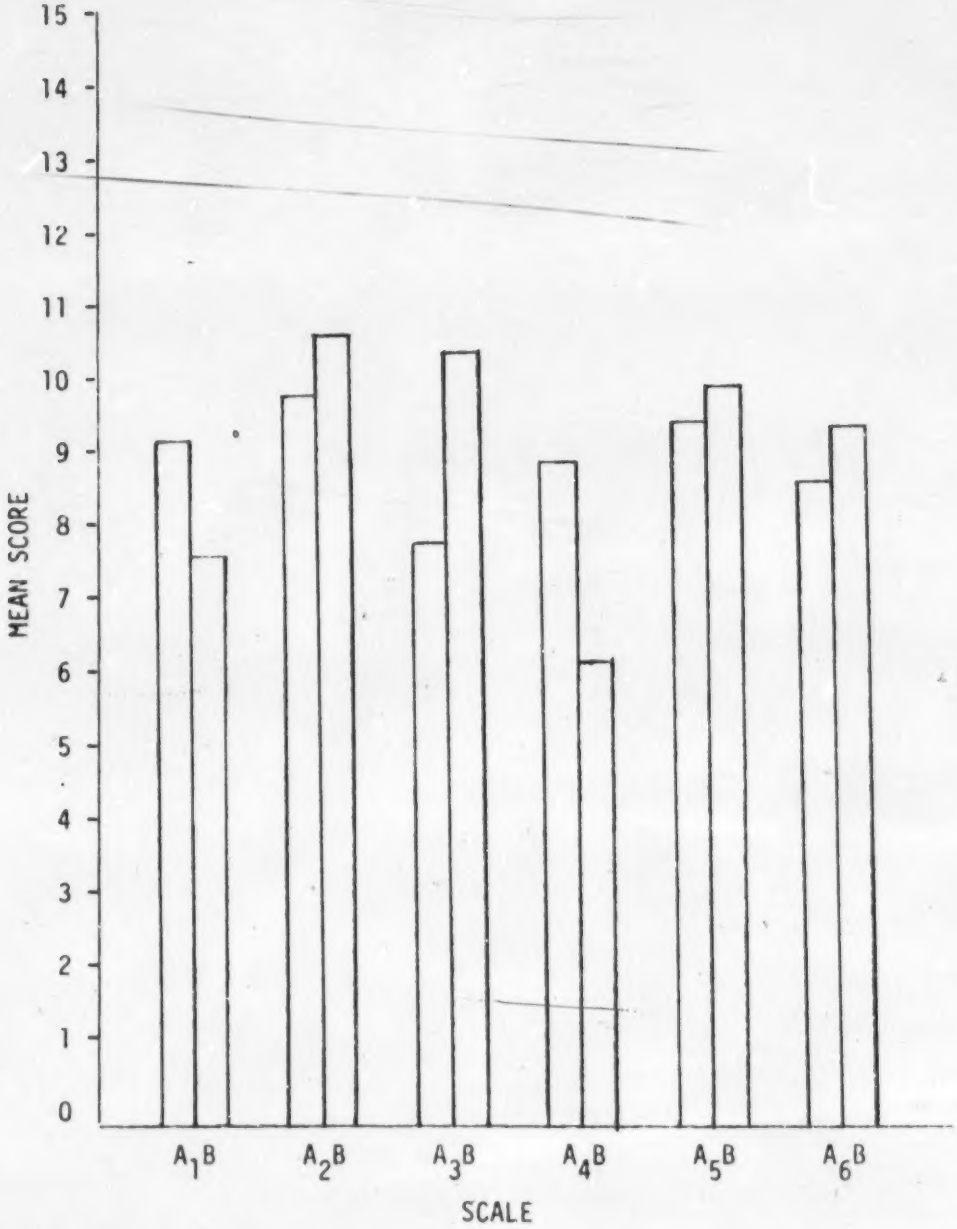

Figure 3. Profile of Mean Scores of Control Grade 7 Students on the Scientific Attitude Inventory.

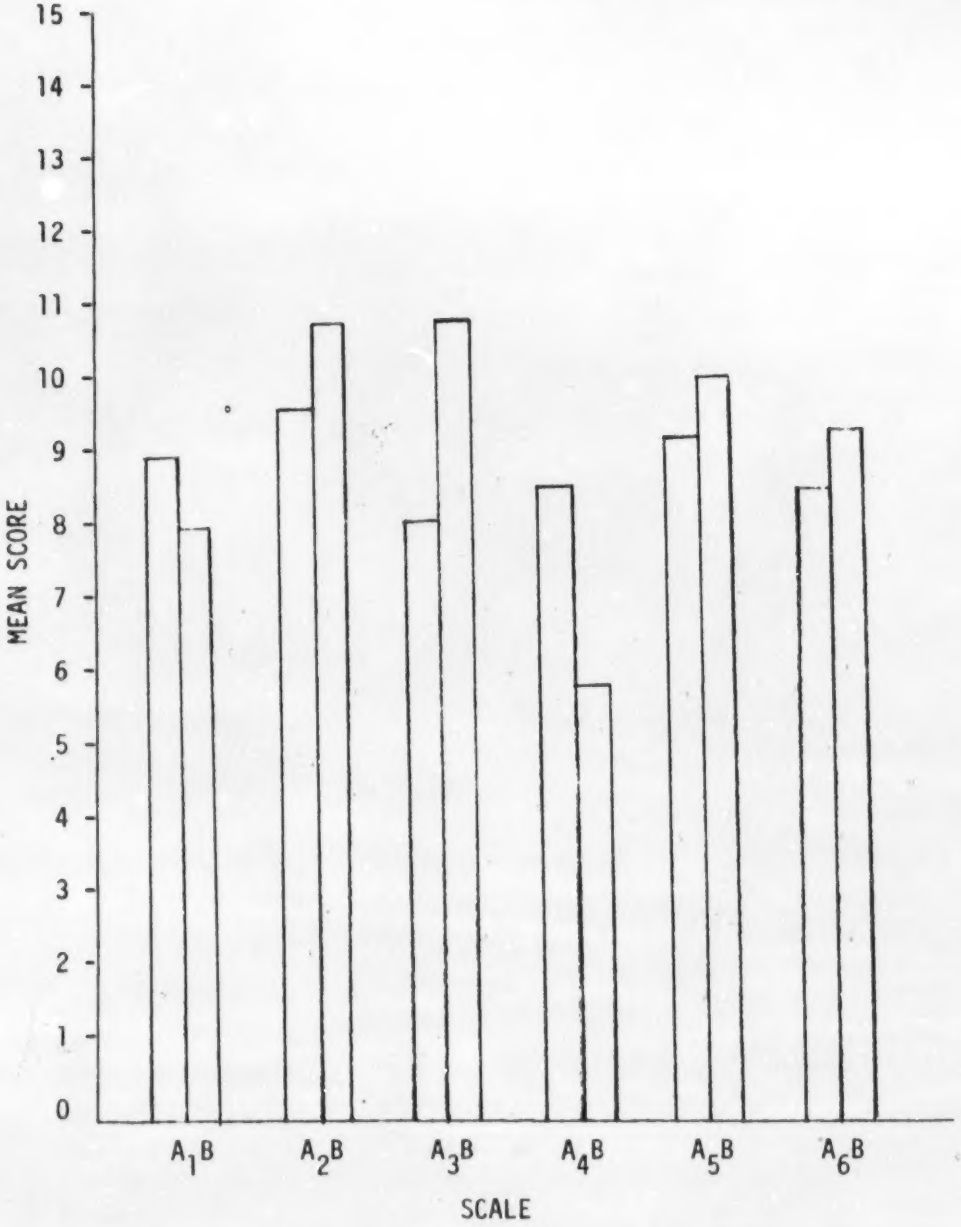

Figure 4. Profile of Mean Scores of Control Grade 8 Students on the Scientific Attitude Inventory.

CONCLUSIONS

The mini-course elective program, as an alternative approach to science instruction at the junior high school, has demonstrated limited success.

1. There was no significant difference in mean achievement or attitude gain scores between the schools, and
2. There was no significant relationship between achievement or attitude scores and general ability across the experimental and control groups for students of different sex or grade level.

NOTE

1. This paper is a summary of author Ronald E. Davies' Doctoral dissertation, "A Comparison of an Elective Mini-Course Science Curriculum and a Conventional Non-Elective Science Curriculum at the Junior High School Level", The Pennsylvania State University, 1977.